MSc Program: Advanced Materials Science

Faculty: Mathematical and Physical Sciences

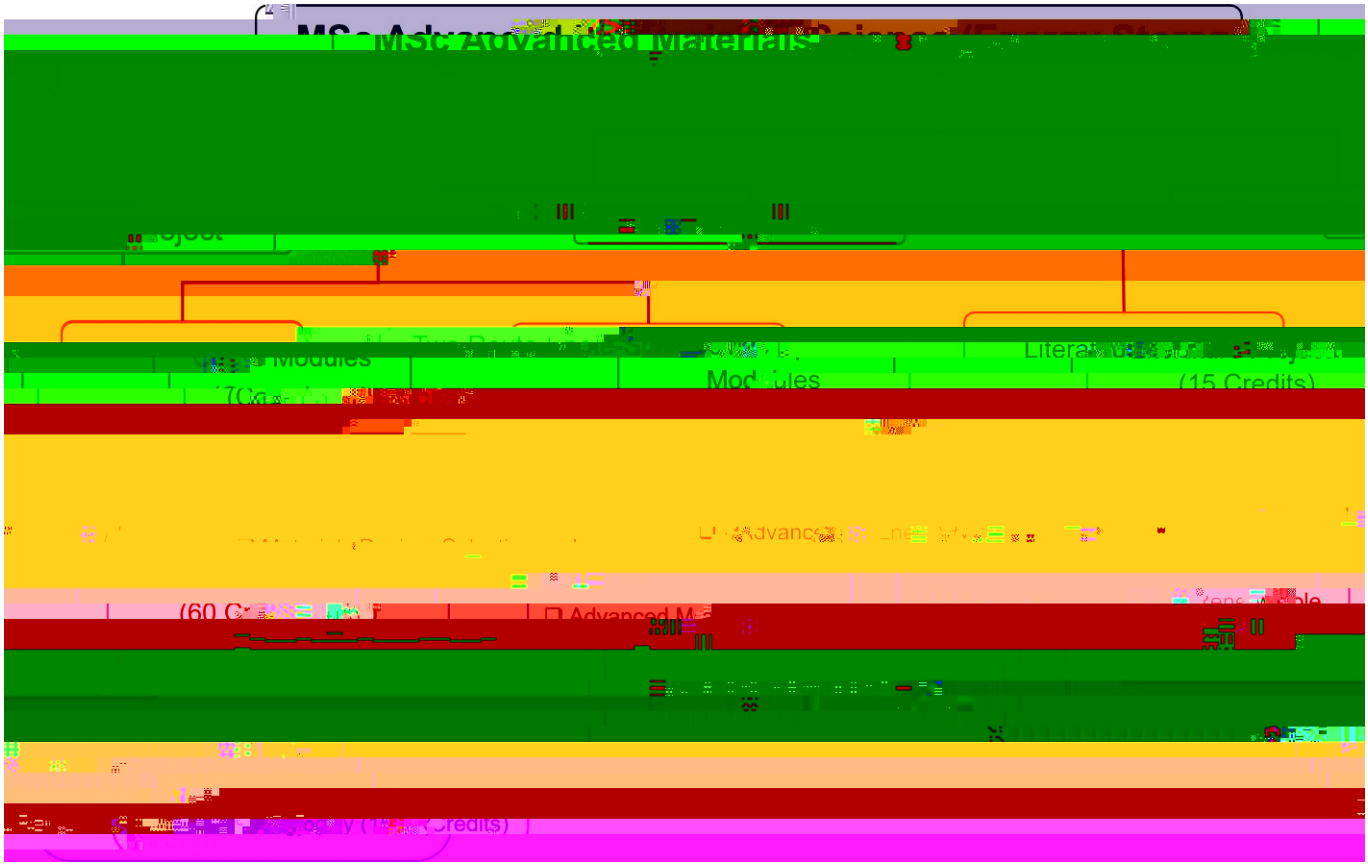
About this degree:

Throughout our MSc program, you will receive the fundamentals of materials science with a focus on cross-team working, real-world scenarios and developing professional skills. You will gain an advanced and comprehensive understanding of the structure, properties and applications of materials in an array of different disciplines, including energy, sustainability, healthcare and products and technology. Students are expected to develop their imagination, critical thinking abilities and laboratory-demonstrating techniques by engaging in a literature survey along with a six-month cutting-edge research project.

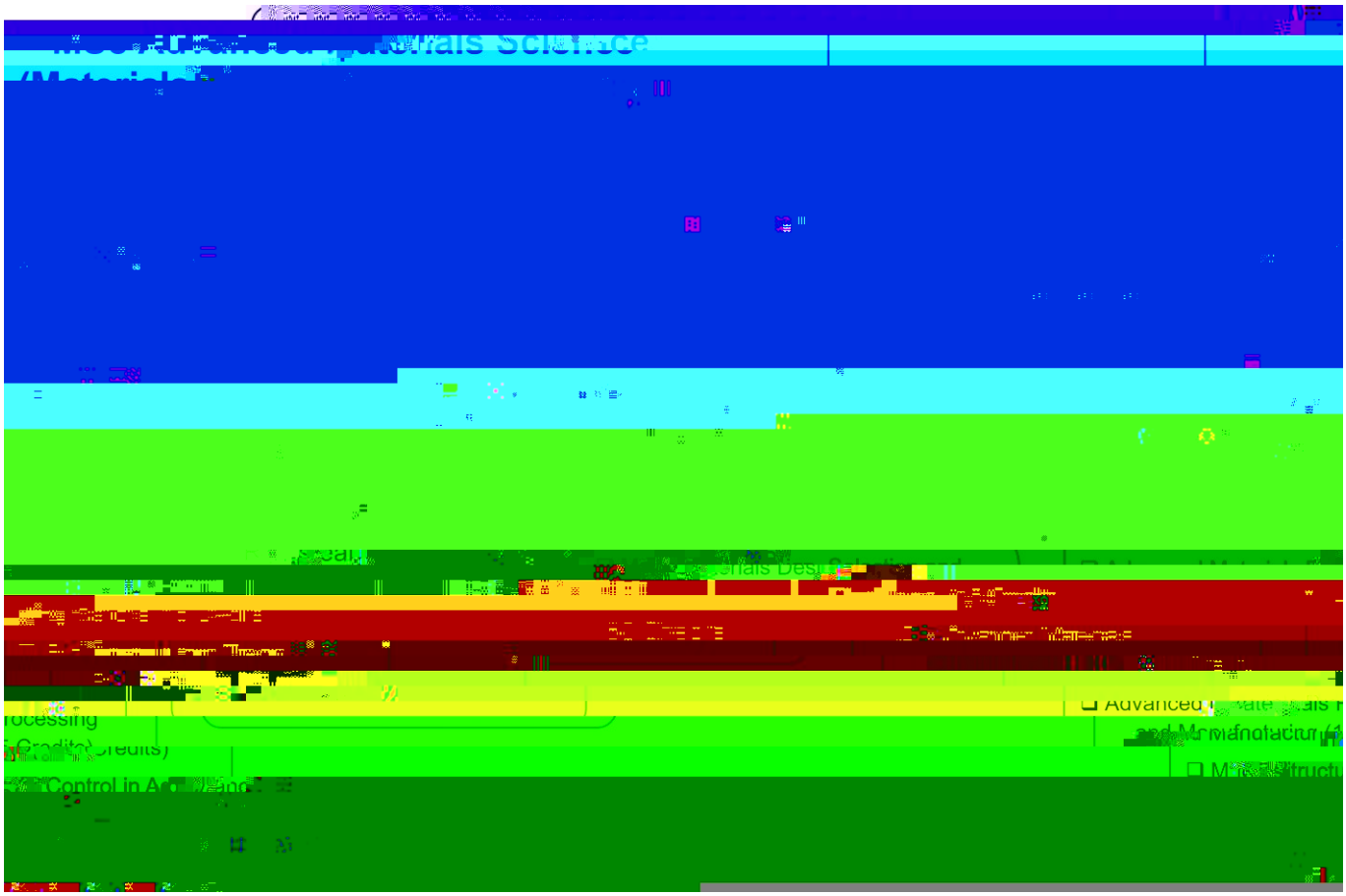
Students undertake modules to the value of 180 credits.

Currently, there are four routes under MSc Advanced Materials Science with specialization in Energy Storage (introduced in the 2019-20 acade4 r000f1 0 0 1 156o500.000008866 0 594.96 842.

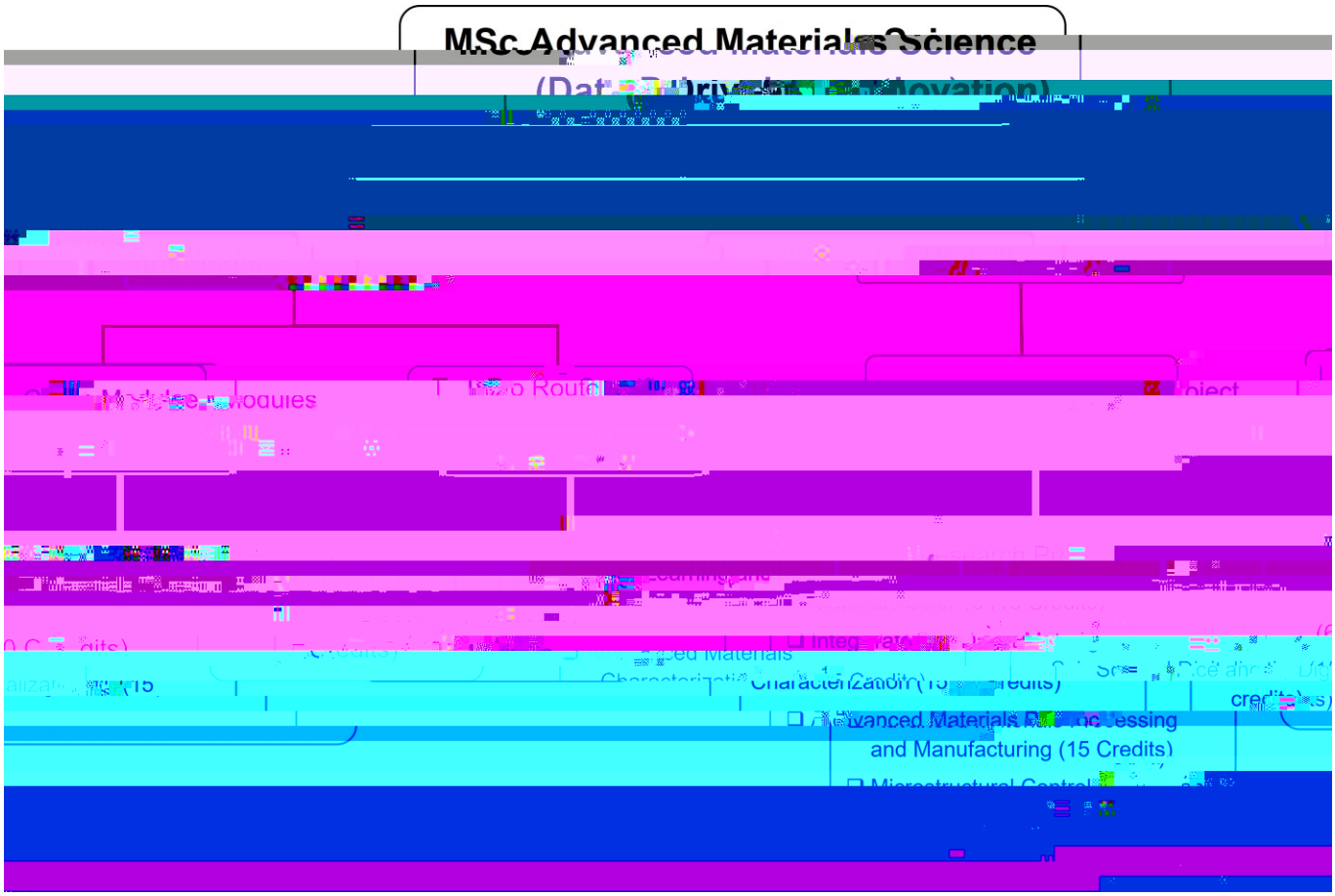
Route 2



Route 4



Route 5


MSc Advanced Materials Science
and Manufacturing (15 Credits)

Core compulsory modules (All core modules are taught by Institute for Materials Discovery at UCL Bloomsbury Campus)

NSCI0009: Microstructural Control in Advanced Materials (15 credits)

The aim of this course is to allow students from various scientific backgrounds (materials, chemistry, physics, engineering, chemical engineering and other relevant science and

NSCI0013: Advanced Materials Characterisation (15 credits)

The course seeks to equip the students with the required knowledge to understand and undertake materials characterization of solid systems. You will cover all the major methods of microscopic, nanoscopic and chemical characterization of materials. The course emphasizes the basic principles behind the characterization techniques as well as equipment design and operation, sample preparation and data analysis. The techniques you will cover are optical microscopy, SEM, Powder X-ray, TEM, AFM, STM, EDS/WDS, PES, SIMS, FTIR/Raman and neutron scattering.

Assessment: Term 2, 40% essay coursework (1200 words) and 60% written exam

NSCI0014: Advanced Materials Processing and Manufacturing (15 credits)

This module presents the process principles and practical knowledge in advanced materials processing and manufacturing, including (a) industrial processing of materials, (b) surface engineering and (c) additive manufacturing, highlighting materials properties and performance during in-service, as well as life cycle design. The understanding of the processing of materials will be reinforced by hands-on laboratory experience in selected materials processing and surface coating technology. Students will also be exposed to industrial guest speakers giving seminars on the use of industrial processing and manufacturing methods of commercial products and devices, essential for a successful career in advanced material development and manufacturing. The knowledge and skills of this module will be enhanced via laboratory demonstration and real experiments, as well as discussion of case studies during tutorials and exposure to guest lectures from the industry. Students will be given the opportunity to synthesise their knowledge and express themselves via a coursework presentation on a selected topic of materials processing and manufacturing.

Assessment: Term 2, 40% presentation/written coursework and 60% written exam

NSCI0015: Research Methodology (15 credits)

The aim of the module is to equip students with the necessary skills and experience to conduct cutting-edge research programs. This includes literature survey methods, critical thinking and analysis skills for identification of novel research topics, experimental design/structuring effective research investigations, data processing and analyzing, scientific report writing, and effective communication via report writing and verbal presentation.

Assessment: Term 1, Innovation Report of 2,000 words, 80%; Statistic problems sheets, 20%.

NSCI0016: Literature Project (15 credits)

The literature project aims to equip students with the skills of performing a scientific literature

NSCI0020: Advanced Energy Storage (15 credits) (Taught by Institute for Materials Discovery at UCL Bloomsbury Campus)

This module aims to provide fundamental knowledge on energy storage mechanisms, to gain the ability to design electrode materials for batteries and supercapacitors, to acquire a good understanding of electrochemistry and electrochemical characterization techniques, to develop skills in electrochemical energy storage device assembly, to highlight the environmental and societal challenges in meeting energy demands, and to appreciate emerging solutions for tackling energy-relevant challenges.

Assessment: Term 1, 40% coursework and 60% written exam.

NSCI0021: Advanced Materials for Sustainable Energy Technologies (15 credits) (Taught by Institute for Materials Discovery at UCL East Campus)

In this module, you will study the current state of innovations in renewable energy sciences with an overview of the major energy conversion types such as mechanical, magnetic, gravitational, electric, chemical and others, understanding their theories, their roles and impacts in our modern society, with a critical evaluation of their true sustainability based on lifecycle analysis. You will be given a historical background, and details on materials and processes of different energy technologies with implications for addressing societal, environmental and global challenges. After this module, you should develop a broad knowledge of the key concepts of current and emerging energy conversion systems at large- and micro-scales such as thermoelectric, solar, wind, geothermal, biomass, heat engines, wave power, electric generators and others. This interdisciplinary course details the scientific concepts and challenges concerning energy generation, conversion and usage. The course aims to develop knowledge of the basic principles governing renewable energy materials and devices. You will learn the impact, roles and current needs for sustainable energy transformation in modern power generation, heating, and transmission as well as scavenging waste energy for a variety of purposes. You will develop a wide range of different abilities and skills, well preparing for future employment in related areas of the energy industry or further studying at a doctoral level.

Assessment: Term 1, 40% coursework and 60% written exam.

NSCI0032: Integrated Data-Driven Materials Science and Digitalisation (15 credits) (Taught by Institute for Materials Discovery at UCL East Campus)

This module provides students with state-of-the-art knowledge and expertise in integrated materials modelling and methods and modern practical cloud-based tools to find and create needed materials and process data for applications in advanced data-driven and machine-learning workflows. It covers contemporary topics in digitalization based on the ontology of materials and processes and connection to manufacturing (digital twins), high throughput computations and characterization, and multiscale, and multi-equation physics-based modelling, including electronic density functional theory (DFT), atomistic molecular dynamics (MD), mesoscopic coarse-grained molecular dynamics (CGMD), granular media (GM) and continuum structural mechanics and computational fluid mechanics (CFD) modelling, enabling modelling technological applications on all relevant scales. Advanced modern tools include cloud-based open e-science materials digitalization and modelling platforms such as https://nanohub.org, https://materialsproject.org, https://www.nomad-coe.eu/the-project/nomad-repository, https://www.materialscloud.org/work/ aiidalab and other emerging platforms.

Assessment: Term 1, 50% essay coursework (1,500 words), and 50% 2-hour in 24-hour window take-h(roje)-2(ct/)Gcrms sr in 24sw (li)4(12 Tf1 0 0 1 118.7 432.43 Tm0.129 g0.129 G[ )]TET9

team and learn how to raise investor finance, or ‘bootstrap’ your business. This course was the first of its kind in Europe, for its single-minded focus on giving you the knowledge, skills, and network to start up a business successfully. We pride ourselves on our rate of successful start-up creation, and every year work to launch more successful start-ups.

Assessment: Terms 1, 60% Group coursework essay (3000 words), and 40% Individual coursework essay (4000 words).

ELEC0031: Nanoscale Processing and Characterisation for Advanced Devices (15 credits) (Taught by the Department of Electronic and Electric Engineering at UCL Bloomsbury Campus)

Engineering in Nanotechnology is concerned with developing, providing and maintaining infrastructure, products, processes and services for society. Engineering in Nanotechnology addresses the complete life-cycle of a product, process or service in the field of Nanotechnology, from conception, through design and manufacture, to decommissioning and disposal, within the constraints imposed by economic, legal, social, cultural and environmental considerations. Engineering in Nanotechnology relies on three core elements, namely scientific principles, mathematics and 'realization'. Scientific principles clearly underpin all engineering, while mathematics is the language used to communicate parameters, model and optimise solutions. Realization encapsulates the whole range of creative abilities which distinguish the engineer from the scientist; to conceive, make and bring to fruition something which has never existed